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## The Lateral Arcades of Certain Emydids and Testudinids

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During many years past the laws of mechanics have played an important role in the interpretation of the vertebrate skeleton. An entirely new aspect of the value of bone was called to attention by the work of Koch ('17) in his study of the human femur. For the first time a detailed calculation of the stresses present in a bone was made and Koch pointed out that the patterns of the bone fibrillae coincided with the computed positions of the lines of stress, both compressive and tensile, that would exist in the femur under normal live loads. Later the present author ('29) showed the application of Koch's principle to the construction of the chelonian pelvis and further pointed out that forces applied from different directions determine the positions of component parts of trusses and arches as represented by their analogues in the chelonian girdle.

Recently a study of the construction of the chelonian skull has been undertaken. During observations on the nature and the fate of the lateral arcades certain very interesting facts have come to light. That these arcades beautifully illustrate the laws of arch and truss construction is without doubt. Variability in form and composition however has been observed to be very remarkable indeed.

With the skull of *Chrysemys picta* (the common painted turtle) Fig. 1, as an example, the orbit is backed by a postorbital and a jugal bone; the latter makes an anterior and ventral contact with the maxillary. These form what is called the postorbital arch. By both the postorbital and the jugal making contact with the quadratojugal a second arcade, the zygomatic, is formed. The latter abuts upon the cranial edge of the tympanic portion of the quadrate, the basal portion of which is somewhat post-like. To this articulates the lower jaw. The body of the quadrate abuts, entad, onto the exoccipital which in turn contributes to the construction of the condyle. Dors-

ally the postorbital makes a synarthrotic union with the frontal and parietal. There is set up by this combination of units a tripartite arch which carries forces in as many directions.

In *Chrysemys* each element comprising this system is a rather broad and flat plate, a condition that is to be regarded as relatively primitive. In other chelonian genera these elements vary from those broader than in *Chrysemys* to ones much narrower. Lines of force passing through these bones would take more or less the same paths whether the arcades be narrow splints or broad plates. The principal difference would be that in the cases of skulls with the broader plates the forces would be less confined in their paths and would dissipate more readily.

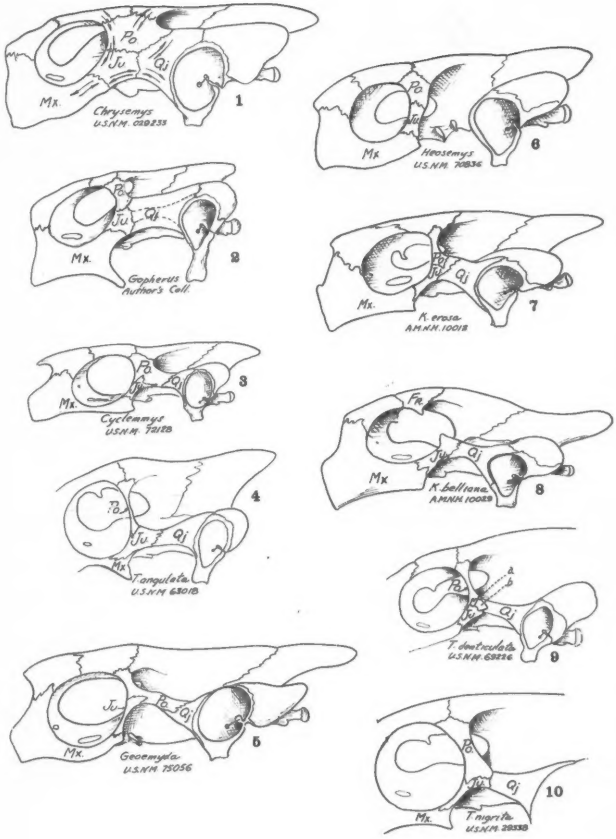
Whenever a force acts in one direction through a resistant system there is always an equal and compensatory force produced within that system to keep it from collapsing.

Thus, when a force passes from a maxillary bone into the jugal the latter sets up a resistant counter force to offset it, as indicated by the arrows in Fig. 1. The jugal in turn may distribute that force into two directions, i. e. through one path into the postorbital and another into the quadratojugal. In each case the respective bones will be subjected to stresses and offer counter resistance. This subdivision of paths will be kept up throughout the entire skull until the forces are carried into the exoccipital from which they will then be transferred to the vertebral column. In addition to the paths above mentioned, forces from the maxillary and jugal may pass entad into the palatine and be carried through this bone to the median axis of the skull, thence to the backbone.

The detailed composition of the tripartite lateral arcades has been studied in a large number of different genera and species; an extensive paper on this subject is in preparation. At the present writing it is thought advisable to give only a few of the more interesting facts about the condition of these arcades in the Emydidae and Testudinidae. These two families are closely related, the latter having a direct decent from the former as can be illustrated by osteological characters other than those found in the skull. The particular bones involved in the study are of course the postorbital, jugal and quadratojugal.

Using *Chrysemys* again as the basic example and a starting point for the discussion it is seen that the three bones in question are about the same size, contribute equally to the composition of the arcades and meet by triradiate sutures in about the geometrical center of the system. We can assume from these proportions that no one element is any more important than any other or bears the brunt of any more forces than any other. If this pattern is compared with that found in such a form as *Gopherus* (Fig. 8) it is evident that in the latter the point of union of the sutures of the bones is no

# PLATE X




LATERAL ARCADES OF SOME TURTLES

longer at the center of the system but shifted anteriorily and the postorbital and jugal combined are now less than the area taken up by the quadratojugal. At the other extreme, when skulls like that of *Cyclemmys* (Fig. 3) and *Geoemyda* (Fig. 5) are examined it is seen that the jugal and quadratojugal have been reduced to secondary rank and the postorbital constitutes about one half the total composition of the arcades. Now, in *Testudo angulata* (Fig. 4) and *Terrapene major* I have found that both the postorbital and quadratojugal are considerably reduced and the jugal proportionately larger than that found in close relatives. In each of these cases the arcades retain their integrity but are so built in comparison with *Chrysemys* that where there is reduction in two of the three elements there is compensation made by the third member.

There are three very significant cases in the Emydidae where the tripartite arch as a system breaks down and leaves merely a single arcade on the lateral side of the skull. I have reference to the cases of *Kinyxis*, *Heosemys*, and *Terrapene* the first from Africa and the second from Siam and central Asia and the last from the new world. In *Kinyxis* it is the postorbital that is lost. In *Heosemys* and *Terrapene* the quadratojugal disappears leaving only a postorbital arcade. Taylor (1894) has already described the remarkable case of *Terrapene* in which a graded series, consisting of *T. major*, *bauri*, *carolina*, *triunguis*, *mexicana* and *ornata* illustrates the gradual loss of the quadratojugal.

Taylor called attention to the loss of the quadratojugal but did not mention particuarly the change in contour of the jugal. In *T. major* the jugal is the largest of these bones and acts as the keystone of the whole system. Apparently this is the maximum development that is reached by this bone; with the loss of the quadratojugal the jugal does not elongate posteriorly to replace the diminishing and eventually lost element, as might be supposed if the integrity of the zygoma is expected to be maintained. In fact, not only does the jugal not elongate but it actually becomes smaller and lighter and in *T. ornata*, the end stage, forms, with a correspondingly light postorbital, a very thin arcade behind the eye. These changes seem to be satisfactory ones for the cranium does not collapse nor has the genus *Terrapene* shown any signs of decadence. It appears that this is merely another expression of the law of conservation. The front half of the lateral surface of the skull appears to be able to function perfectly satisfactorily without being connected with the quadrate region by means of an arcade. The role played by an element lost in the evolutionary process need not be taken over by another element, as long as the resulting machine is reasonably securely built.

I have examied species of *Cyclemmys*, *Geoemyda*, and *Heosemys* all genera being of Asiatic origin. Within these three genera a story like that in the single genus *Terrapene* can be told. In this instance,

however, while the quadratojugal again is lost, eventually, it is the postorbital instead of the jugal that is the largest of the three bones and acts as the keystone. Like the jugal the postorbital does not replace the quadratojugal as the latter diminishes and is lost, and similarly it is reduced to relatively smaller size in the end stage i. e. *Heosemys*. (Figs. 3, 5, 6).

In these two cases the pattern of the end stage reached is the same. In one the progression takes the form of changes in six species of one genus while in the other it occurs within a series of genera. That the same end stage has been reached independently by two groups or organisms related as far as family goes, but found in remote geographical localities is indeed very remarkable. I think that we will have to agree that a genus like *Terrapene* is a more plastic one than any single one of the several genera in a composite series. It would be most enlightening if a single species could be found in which a parallel series of changes occured in its various individuals. The manifestation of a parallelism in geographically isolated but related forms I believe has to be interpretated in terms of some evolutionary trend inherent in the germplasm of the whole order to which these organisms belong, in this case the Chelonia.

In the genus *Kinixys*, (*K. erosa, homeana,* and *belliana*) again a lateral arcade breaks down but this time it is the postorbital, so that the orbit becomes confluent with the temporal fossa. This is accomplished by the loss of the postorbital bone. In *K. erosa* (Fig. 7) the arcades are complete but the postorbital bone is the thinnest of the three constituents. The same is true of *K. homeana.* In both these the quadratojugal is largest and the jugal next in size. In *K. belliana* (Fig. 8) there is no postorbital, but I have been unable to find any individuals or species that show the *gradual* loss of it. It appears to be lost all at once.

In contrast with the cases of *Terrapene* and *Heosemys* where the two remaining bones diminished in size after the loss of the third, in *Kinixys* the jugal and quadratojugal become more developed in the end stage. The emphatic growth of the quadratojugal is significant. In *K. belliana* it extends well forward and could possibly meet the maxillary if there were reason for it doing so. Since forces initiated in the maxillary cannot be diverted into the roof of the skull, due to the loss of the postorbital, they must pass into the zygomatic arcade. From the standpoint of mechanical efficiency it appears that the postorbital arch is a stronger one than the zygomatic if each exists by itself. When both exist in the same individual there is little to choose from as to their respective strengths. It is perfectly possible then that the postorbital arcade may become reduced in size when its companion is broken down, but it is necessary for the zygomatic arch to hypertrophy when the postorbital bone disappears. The amount of bone used in any single or composite system

is always inversely proportionate to the minimum strength of that system and directly proportionate to the number of forces dissipated through it.

Occasionally cases have been found, which through faulty development have produced incomplete tripartite arcades where perfect ones should occur. Each of the bones in question is of dermal origin and each has its own center of ossification. The geometric positions of these centers in relation to one another may vary. This certainly occurs in different genera and may possibly in individuals of a single species. Whether or not this is determined by a genic inheritance is not definitely known; it may possibly be so. If for some reason the process of ossification of these three bones, the jugal, postorbital, and quadratojugal is such that the plates formed from the respective centers do not meet properly and a hiatus between these is left, where normally there should be no such space, the archways would of course be incomplete and, unless rectification for the deficiency were made, reciprocal forces could not pass from one element to another and the system as a whole would collapse. In Fig. 9 is a case of *Testudo denticulata;* here two supernumerary bones form small links that join the jugal, postorbital and quadratojugal, these in their own right being too short to meet mutually and complete a tripartite arcade. Normally the two supernumeraries are lacking and the three bones constituting the arches meet.

In the Testudinidae occur some interesting cases of variation in the proportions of the three bones, the jugal, postorbital and quadratojugal. *Chrysemys picta* has been used as a central type for the purposes of comparison. In this genus the three bones are approximately mutually equal, the jugal being but slightly smaller than the other two. Each contributes about equal strength and support to the archways. As the Testudinidae have evolved from the Emydidae their skulls have become definitely brachycephalic and high domed with pronounced buttress-like lateral arches. The general impression given by a testudinid skull is one of light weight, delicacy, and fenestration. In all species of this family the orbit is considerably enlarged, the temporal fossa extended well forward, at least more so than in most other families and the suprapterygoid fossa is much arched.

The resulting bones separating these spaces are narrowed down considerably, in fact to mere splints in some cases, yet sufficiently strong to prevent dissociation of the arcades. A similar situation appears in the higher and more specialized Emydidae, such as *Geoemyda, Nicoria,* and *Cyclemmys* only here the skulls are dolichocephalic and not particularly domed.

In the majority of the species of *Testudo,* while the jugal, postorbital, and quadratojugal are narrow and thin they are not particu-

larly disproportionately built. This is true of *T. pardalis*, *T. radiata*, and *T. ephippium*. However in *T. tornieri* the postorbital while not very narrow is considerably smaller than the other two which are about equal in size; in *T. angulata* (Fig. 4) the postorbital is long and narrow splint-like piece and does not articulate with the quadratojugal, a condition somewhat reminiscent of *Kinixys* where the jugal and quadratojugal are much enlarged; in *T. nigrita* (Fig. 10) the jugal becomes much more splint-like than usual and the heavier arch swings around the front border of the temporal fossa and consists of the relatively broader postorbital and quadratojugal bones. In Go the relatively broader postorbital and quadratojugal bones. In *Gopherus polyphemus* (Fig. 2) cited earlier both the jugal and postorbital are proportionately small and the quadratojugal larger, although the latter may, in some individuals become rather long and narrow. The dotted lines in Fig. 2 indicate the maximum reduction that has been found to occur in this species.

Where the tripartite archways persist as complete systems it appears that when the three component bones are not equally developed it may be any one of the three that suffers reduction, but when this happens the other two compensate for that reduction and evident in *T. nigrita* for instance that the major forces pass through the quadratojugal-postorbital combination; in *T. angulata* that the main paths would be through the jugal-qudratojugal (zygomatic arch) complex and at times in *Gopherus* that the major stresses apparently withstand the extra stress developed therein. It seems would occur in the jugal-postorbital path.

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# Notes on Scaphiopus hurterii Strecker

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In 1934* I referred several specimens of *Scaphiopus* from a locality near Lexington, Oklahoma, to the species *holbrookii holbrookii*. At this time no adults of the latter species were available from Eastern United States. Since then a series of large specimens from Kentucky has been obtained. Comparisons of these with specimens from Texas, Oklahoma, and Arkansas have shown that two separate species of this group of *Scaphiopus*, *holbrookii holbrookii* and *hurterii*, are involved.** The latter species may be distinguished from the former, its closest relative, by the shape of the skull, maximum size attained, and by other less obvious characters.

Two skeletons of *holbrookii holbrookii* are available from Mammoth Cave Ridge, Edmonson Co., Kentucky, collected by C. W. Hibbard on June 21, 1935, and five skeletons of *hurterii*, three from Somerset, Bexar Co., Texas, and two from a locality near Lexington, Cleveland Co., Oklahoma, collected by Dr. Edward H. Taylor and myself on June 3, 1932.

The skulls of the two species differ markedly in their relative width and depth (mandibles attached). The skulls of *hurterii* are much deeper, due to an elevation of the frontal and parietal areas. The greater depth of the skulls of this species is not due to a greater coossification of skin and bone, for both species have the skin between and in front of the eyes partially coossified with the bones below. The greatest elevation of the cranium in *hurterii* is about one-fourth higher above the foramen magnum than in *holbrookii*.

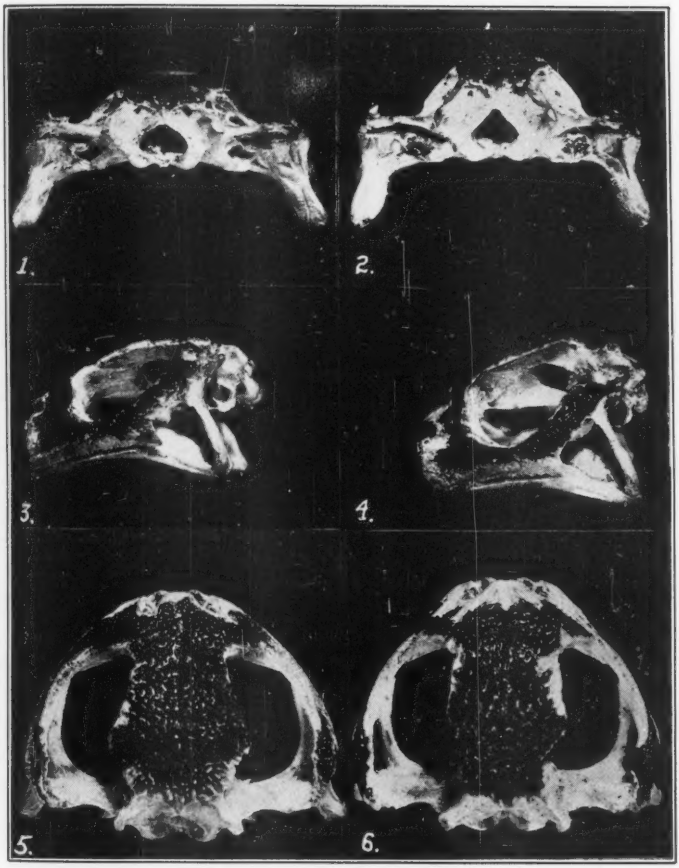
The sides of the cranium between the orbits differ in character in the two species. In *hurterii* the sides are parallel or divergent to a point slightly posterior to the middle of the orbits; posterior to this point (which forms more or less of an orbital process) the sides are convergent, and approach each other somewhat more closely than at the anterior part of the interorbital region. The sides are continuous with a bony ridge of the frontoparietal terminating in a process on each side above and lateral to the occipital condyles, composed also, apparently, of the exoccipital and prootic bones.

In *holbrookii*, the sides of the cranium between the orbits are divergent to a point near the posterior border of the orbits; poster-

*Smith, Hobart M. and Arthur B. Leonard. Distributional records of reptiles and amphibians in Oklahoma. Amer. Midl. Nat., vol. 15, no. 2, 1934, pp. 190-196.

**Since this was written specimens from Massachusetts, New Jersey, North Carolina, Florida and Mississippi have been examined. These appear to be typical holbrookii holbrookii.

## PLATE XI




Figs. 1, 3, 5, Skull of Scaphiopus h. holbrookii, posterior, lateral, and dorsal views, respectively. Actual length of skull, 18 mm.; width, 25.3 mm.; depth, 10.7 mm. Female, Edmonson Co., Kentucky, June 21, 1935, C. W. Hibbard, collector.

Figs. 2, 4, 6. Skull of Scaphiopus hurterii, posterior, lateral, and dorsal views respectively. Actual length of skull, 19 mm.; width, 23.6 mm.; depth, 12.5 mm. Female, Somerset, Bexar Co., Texas, May 29, 1935, A. J. Kirn, collector.

ior to this point the sides are strongly convergent, and are continuous with a ridge terminating in a process essentially similar to that in *hurterii*.

In preserved and live specimens, as well as in the prepared skulls, the elevated area of the skull, the cranial boss, is much more pronounced in *hurterii* than in *holbrookii*. This elevation is distinct and of the characteristic shape even in the youngest specimen available of *hurterii* (54.5 mm.), while only a slight convexity is apparent in specimens of *holbrookii* of the same size.

The largest specimen available of *holbrookii* (74 mm.) does not exhibit any tendency toward a development with greater age of a strongly accentuated interorbital elevation of the same shape as that which is always characteristic of specimens of *hurterii*.

The distance from the orbit to the nasal aperture (in the skulls) is relatively greater in *hurterii* than in *holbrookii*. Correlated with this is the relatively larger size of the eyes in *holbrookii*. The foramen magnum in *hurterii* is as long as broad, while in *holbrookii* it is broader than long. The variation in *hurterii* with respect to the relative width and length of the skull overlaps the variation in *holbrookii*, but the elevation of the skull is invariably greater in the former, when compared with specimens of equal size of the other species.

The maximum size of *holbrookii* (74 mm.) is less than that of *hurterii* (81 mm.); and the average size of adult specimens available of *hurterii* is greater than the average size of available adult *holbrookii*.

Usually numerous small, black spines on the head are present in *holbrookii*, reduced in number between and in front of the eyes. In *hurterii* very few or no spines are present in this area. The presence or absence of pustules on the hind leg is not diagnostic.

Wright (Handbook of Frogs and Toads, 1933, p. 44) states: "Mr. Kirn's (June 28-29, 1931) material when compared with male *S. holbrookii* of the same size, has smaller measurements. The head to angle of mouth, the width of the head, the tympanum (equal in one), the snout (greater in one) were less than in *S. holbrookii*. The hind limbs were equal in the two species." As can be observed in the accompanying tables, these differences are not constant.

In coloration there is but little difference between the two species. The dorsolateral light stripes are usually more evident in *holbrookii* than in *hurterii*.

*S. hurterii* has a broad area of distribution, including eastern and central Texas, Oklahoma and western Arkansas. Specimens have been examined from the following localities: OKLAHOMA: 2 mi. N of Lexington, Cleveland Co. (EHT & HMS 78-91, 93, 95100, 234-236). ARKANSAS: 2 mi. E of Ozark, Franklin Co. (KU 18556, J. D. Black). Texas: Benton, Atascosa Co. (EHT & HMS 171; KU 787-817, E. H.

Taylor and A. J. Kirn; Lytle, Atascosa Co. (KU 11328-9, 15659-60, A. J. Kirn); Somerset, Bexar Co. (KU 19796-19854, 19877-19937, A. J. Kirn).* It seems likely that Ortenburger's report (Copeia, No. 163, 1927, p. 46) of *holbrookii* from Cimarron Co., Oklahoma, is referable to *hurterii*.

Among the specimens examined of *holbrookii holbrookii* are three from Arkansas: Caraway, Lawrence Co. (KU 9444-5, B. C. Marshall); Imboden, Lawrence Co. (KU 17601, B. C. Marshall). Numerous other specimens have been examined from localities well within the known range of *holbrookii*.

It is not certain that *hurterii* and *holbrookii holbrookii* do not intergrade. However, at present there are no specimens available which indicate intergradation. Apparently a gap exists in the central part of Arkansas and Louisiana between the ranges of the two forms.

Measurements of *Scaphiopus holbrookii* (Harlan)

| Number | 19774 | 17607 | 19856 | 19776 | 19862 | 19771 | 19775 | 19857 | 19864 | 17601 |
|---|---|---|---|---|---|---|---|---|---|---|
| Collection | KU | KU | KU | KU | KU | KU | KU | KU | KU | KU |
| Length | 58.5 | 60.5 | 63.0 | 63.5 | 64.5 | 66.5 | 66.5 | 66.0 | 66.0 | 74.0 |
| Head length | 17.7 | 16.7 | 18.8 | 18.5 | 19.3 | 18.1 | 18.8 | 19.0 | 17.8 | 18.2 |
| Head width | 23.9 | 22.9 | 24.8 | 24.0 | 27.2 | 24.8 | 23.5 | 26.1 | 25.0 | 24.1 |
| Snout | 6.2 | 5.9 | 7.2 | 7.8 | 7.2 | 7.2 | 7.2 | 6.7 | | 7.4 |
| Diameter of eye | 7.3 | 6.8 | 7.1 | 7.8 | 7.8 | 7.0 | 7.0 | 8.2 | 7.5 | 7.2 |
| Interorbital width (minimum) | 7.8 | 7.5 | 7.5 | 7.0 | 7.8 | 7.6 | 7.6 | 7.0 | 8.7 | 7.5 |
| Tympanum | 4.1 | 3.9 | 5.1 | 5.0 | 4.7 | 4.9 | 4.5 | 5.7 | 5.7 | 4.6 |
| Leg | 72.0 | 72.0 | 70.0 | 79.0 | 76.0 | 70.0 | 71.0 | 70.0 | 77.0 | 75.0 |
| Tibia | 20.9 | 18.9 | 19.6 | 21.2 | 22.0 | 19.0 | 21.3 | 20.4 | 22.0 | 20.2 |
| Foot | 31.2 | 33.3 | 30.0 | 33.2 | 32.0 | 30.0 | 32.0 | 31.0 | 32.0 | 32.9 |

Measurements of *Scaphiopus hurterii* (Strecker)

| Number | 19851 | 18556 | 234 | 171 | 19934 | 787 | 19813 | 11328 | 11329 | 19886 | 19893 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Collection | KU | KU | EHT | EHT | KU | EHT | KU | KU | KU | KU | KU |
| Length | 55.0 | 66.0 | 66.5 | 69.5 | 68.5 | 71.0 | 73.9 | 75.5 | 77.0 | 79.0 | 81.0 |
| Head length | 16.5 | 17.5 | 16.3 | 19.8 | 20.1 | 18.8 | 19.1 | 20.2 | 20.8 | 21.2 | 21.2 |
| Head width | 21.5 | 23.5 | 23.0 | 27.0 | 25.0 | 26.5 | 25.1 | 28.9 | 29.5 | 27.7 | 30.0 |
| Snout | 5.6 | 6.5 | 6.4 | 7.5 | 7.0 | 5.9 | 7.0 | 6.8 | 7.7 | 7.9 | 7.0 |
| Diam. of eye | 7.0 | 6.7 | 7.0 | 7.8 | 7.5 | 8.0 | 8.0 | 8.0 | 8.8 | 8.0 | 9.0 |
| Interorbital width (minimum) | 7.1 | 7.2 | 7.0 | 7.8 | 7.5 | 7.1 | 7.0 | 8.2 | 8.3 | 8.0 | 8.5 |
| Tympanum | 4.0 | 4.9 | 4.0 | 5.0 | 5.5 | 5.5 | 5.7 | 6.0 | 6.6 | 6.0 | 6.5 |
| Leg | 61.0 | 69.3 | 69.0 | 81.0 | 32.0 | 73.0 | 81.0 | 85.0 | | 92.0 | 98.5 |
| Tibia | 16.8 | 19.0 | 18.6 | 22.3 | 23.1 | 21.2 | 21.1 | | | 25.2 | 25.9 |
| Foot | 28.0 | 29.7 | 30.5 | 35.0 | 34.0 | 36.0 | 37.9 | 37.0 | 41.0 | 43.0 | |

*The National Museum has specimens (not seen) from Near Santa Rosa, Cameron Co.; Edna, Jackson Co.; McLennan Co. (Texas). Strecker (Proc. Biol. Soc. Wash., 23, 1910, p. 116) records specimens from Waco (type locality), McLennan Co., and Refugio, Refugio Co.

# Notes on Three Utah Lizards

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The following study deals with three species of lizards which occur in parts of Utah, but are not common over most of the state.

**Cnemidophorus sexlineatus perplexus** Baird and Girard

For several years the writer has been searching for, and whenever possible, collecting this Sonoran race runner. It was found to be moderately abundant during the early mornings of June 27, 1933 and July 8, 1934, in the red sandstone canyon along Kanab Creek, six to seven miles north of Kanab, Utah. An examination of the stomach contents of 15 specimens, collected among tall sagebrush and rabbitbrush, revealed the following insects and spiders to be present in recognizable form: Eleven Orthoptera in 8 stomachs, of which 5 were nymphal and 3 adult grasshoppers, and 2 sand crickets; 1 Hemiptera, a pentatomid bug; 2 Homoptera, 1 being an aphid; 10 Lepidoptera, all caterpillars; 1 fly; 3 beetles; and 4 spiders in 1 stomach. This species apparently was exceeded in abundance in this locality by *Sceloporus graciosus graciosus* (BAIRD AND GIRARD), *Cnemidophorus tesselatus tesselatus* (SAY), and *Uta stansburiana stansburiana* (BAIRD AND GIRARD); it was more abundant than *Uta levus* STEJNEGER which was present among the taller brush and on rock facings along the sides of the canyon. An examination of the stomachs of 9 specimens taken near Orderville, Utah, June 27, 1933 and July 11, 1934, among much shorter rabbitbrush and sage than in the case above, and 6 specimens taken nearby Glendale, on the latter date, disclosed 4 Neuroptera, larvae; 7 Orthoptera, 1 being a sand cricket and the rest grasshoppers, of which 4 were nymphs; 3 Hemiptera; 5 Homoptera, all leafhoppers, 1 being a beet leafhopper, *Eutettix tenellus* (from Orderville); 23 Lepidoptera, all caterpillars, in 11 stomachs; 12 adult and 4 arval Coleoptera in 10 stomachs; and 13 Arachnida, 12 being spiders, in 8 stomachs. These lizards were taken near points where the highway approached the foothills. Two specimens of this lizard were collected in brush, 2 miles southwest of St. George, Utah, September 18, 1935; their stomachs contained 1 grasshopper; 1 beetle; 1 Hemiptera; and 1 ant. A single specimen, collected among Russian thistle at Blanding, Utah, June 21, 1934, had recently eaten 4 lepidopterous caterpillars; 1 grasshopper; and 2 beetles.

Specimens of *perplexus* usually were more difficult to collect than were the *tesselatus* taken in the same localities; the *perplexus* dodged out of sight quickly, even during the cool period of early morning. All specimens observed were upon the ground, no climbing being evident.

Among the unpublished notes of Dr. H. J. Pack are records of his having collected "*C. gularis*" at Paragonah, Utah, June 7, 1920 and July 2, 1921, "upon the ground among sagebrush, not far from a small stream of water"; at Zion National Park; and at Bluff, San Juan County, Utah.

**Sceloporus occidentalis biseriatus** (Hallowell)

A mature specimen of the blue-bellied lizard was observed to be chasing a full-grown *Uta stansburiana stansburiana* up to the concrete wall of a powder house at Dolomite, Utah. The pursuit seemed to be more vicious than the usual friendly "game of tag" indulged in by pairs of *biseriatus* during courtship. As the *Uta* reached the lower corner of the eves it was shot with a .22 rifle, while still on the run; as it fell it was pursued to the ground by the blue-bellied lizard which quickly turned and ran up the wall again to the point at which the *Uta* had been shot. Fearing that this lizard might escape in some crevice under the roof, it was shot and both specimens were examined carefully as to identity. Stomachs of 4 *biseriatus* specimens, collected near Dolomite, Utah, June 14 and July 9 and 11, 1933, contained 1 cricket and 5 grasshopper nymphs; 3 lepidopterous caterpillars; 4 false chinch bugs, 3 being nymphs; and 2 beetles. Another specimen, taken among rocks 2 miles southeast of Timpie, August 11, 1933, had ingested 2 adult grasshoppers, *Melanophus mexicanus*, and 1 ground beetle. A specimen taken near Blanding, June 30, 1934, contained 4 Hymenoptera, 3 being ants. The stomach of a specimen from Pine Creek, Utah, July 8, 1934, held 4 beetles, 3 of them Chrysomelidae; and 1 Hemiptera. Two specimens, taken near Newcastle, July 9, 1934, recently had eaten 29 ants, 1 fly, 1 aphid, and each stomach contained parasitic roundworms, 10 and 5, respectively. In addition, one *biseriatus* was collected at Enterprise, and two in Iron County, 15 miles north of Mountian Meadow, Utah, May 1, 1918, by C. J. Sorenson and H. R. Hagen.

**Sceloporus undulatus elongatus** Stejneger

Dr. Charles E. Burt examined specimens collected at Trout Creek, Utah, during May of 1934, and considered them as this species, making the comment "Some of the Trout Creek specimens of *Sceloporus* have a low count of dorsal scales between the occiput and the base of the tail (not over 43) and when there are 42 I regard them as *biseriatus*. These specimens are practically inter-grades between *biseriatus* and *elongatus*, but I regard them as being closer to the latter in average characters". Ninety-two stomachs from species of this lizard have been examined during the years 1930 to 1936. Stomachs from 4 specimens collected at Blanding, Utah, during 1934 contained 5 beetles, all but 1 of injurious families; 2 Lepidoptera; 20 Hymenoptera of which 19 were ants; and 2 spiders. Stomachs of 4 specimens from Dolomite held 2 Hemiptera, 1 a pentatomid; 4 Homoptera, all beet leafhoppers, *Eutettix tenellus* (Baker); 7 Coleoptera, 5 being weevils; 1 lepidopterous larva; 25 Hymenoptera, 21 being ants; and 1 spider. One specimen taken at Fruita, Utah, September 20, 1935, contained 1 beet leafhopper; 17 ants; and 1 spider. Eleven stomachs from Gusher, Utah, held 1 centipede; 1 grasshopper; 4 Hemiptera; 2 leafhoppers, 1 a *Eutettix tenellus;* 10 Coleoptera, 1 being a larva; 4 Lepidoptera, 2 being caterpillars; 58 H menoptera, 53 being ants. Four specimens from Kanab recently had eaten 2 Hemiptera; 1 Homoptera, a beet leafhopper; 4 beetles; 3 lepidopterous caterpillars; 8 ants; and 1 spider; 8 parasitic roundworms also were present. At Timpie 5 specimens were collected; the stomachs containing 8 Hemiptera; 1 beet leafhopper; 1 horsefly; 1 beetle; 2 Lepidoptera; 37 Hymenoptera, 34 being ants; and 1 spider. The food in the other stomachs examined likewise consisted almost entirely of insects and spiders. Other Utah localities from which specimens were collected include Duchesne, Mount Carmel and Torrey.

# A Miocene Lizard from Nebraska

EVERETT CLAIRE OLSON .....
Walker Museum, University of Chicago

Skeletal remains of lizards are not particularly uncommon in the non-marine Eocene and Oligocene strata of North America, but heretofore, no members of the Lacertilia have been described from beds of Miocene age in this country. Recently, Paul O. McGrew of the Department of Geology and Paleontology, University of Chicago, turned over to me a well preserved lacertilian lower jaw collected by his party during the summer of 1936 from the Lower Harrison Beds near Agate, Nebraska. The present paper is devoted to a description of this form and a discussion of its probable relationships. While studying this specimen it became necessary to examine the dentition of many modern genera of lizards. The excellent collections of the Field Museum of Natural History were made available to the writer for this purpose by Karl P. Schmidt and D. Dwight Davis of that institution. I wish to express my sincere thanks for their generous cooperation.

## Iguanidae

### TETRALOPHOSAURUS gen. nov.

GENOTYPE.—*Tetralophosaurus minutus*.

DIAGNOSIS.—Teeth pleurodont; crowns spatulate, fundamentally tricuspid, but bearing a small, anterior, fourth cusp.

### TETRALOPHOSAURUS MINUTUS sp. nov.

HOLOTYPE.—University of Chicago, no. 1546. Consists of portion of left dentary bearing nine teeth and a small fragment of coronoid.

HORIZON AND LOCALITY.—Lower Harrison Beds near Agate, Nebraska.

DIAGNOSIS.—The length of the preserved portion of the jaw is 5 mm. The dentary and coronoid possess no unusual or diagnostic characters. The dentition is strictly pleurodont. The teeth have cylindrical roots, crowns somewhat expanded in the axial plane, and four cusps arranged in line parallel to the long axis of the dentary. The fundamental pattern of the crown is tricuspid, the fourth cusp consisting of a small anterior prominence visible on most teeth from the inside of the jaw only.

DISCUSSION.—A comparison of *Tetralophosaurus minutus* with representative extant genera of the various families of the Lacertilia indicates that this form is a member of the Iguanidae. Pleurodont dentition, expanded crowns, and a tricuspid pattern with an anterior accessory cuspule are characters which occur together only in that

family. Lateral teeth with a straight, tricuspid crown are characteristic of the Iguanidae, but certain genera, such as *Uta*, possess essentially conical lateral teeth. Certain herbivorous genera have teeth which, like those of *Tetralophosaurus*, possess somewhat expanded crowns. *Conolophus*, *Amblyrhynchus*, *Phymaturus*, and *Iguana* may be cited as examples. The lateral teeth of *Iguana* have distinctly denticulated crowns, those of *Phymaturus* and *Amblyrhynchus*, a tricuspid pattern, while those of *Conolophus* are tetracuspid.

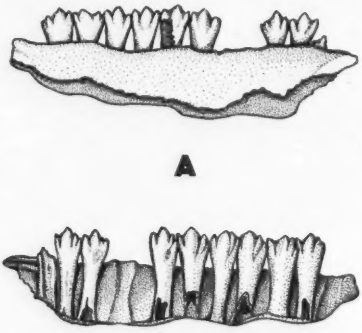


Fig. 1.—Left lower jaw of Tetralophosaurus minutus (University of Chicago, No. 1546). xs 10. A, external aspect; B, internal aspect.

The lateral teeth of *Tetralophosaurus minutus* of the Miocene, although much smaller, resemble those of *Conolophus* very closely. In *Conolophus* the roots are slightly compressed and the crowns curve medially, in *Tetralophosaurus* the roots are cylindrical and the crowns uncurved. However, except for size, there is no more difference between the teeth of *Tetralophosaurus* and *Conolophus* than between the individuals of the genus *Conolophus*.

Because very little work has been done on the dentition of the Lacertilia it is difficult to evaluate accurately the significance of similarities and differences in the dentition of various forms. As pointed out above there seems to be a definite correlation between crown pattern and diet among the Iguanidae, a broad crown developing in rather widely separated genera. Because of the possibility of parallelism it seems unwise at present to assert definitely that *Tetralophosaurus* and *Conolophus* are closely related. The available evidence, however, suggests the probability of such a relationship. More definite conclusions can be reached only when new and more complete specimens of *Tetralophosaurus* are discovered.

# The Amphibians and Reptiles of Randolph County, West Virginia

N. Bayard Green
Davis and Elkins College, Elkins, W. Va.

Randolph County is situated in east central West Virginia between the parallels of 38° 23′ and 39° 08′ North latitude and the meridians of 79° 20′ and 80° 17′ West longitude.. At the nearest point it is less than five miles from the Virginia State line. Its greatest length is 64 miles; its greatest width 33 miles. The total area is 1046.33 square miles. The elevation varies from 1750 to 4760 feet above sea level. The county is drained in part by the Cheat, Tygart, Middlefork, and Buckhannon Rivers which flow into the Monongahela; and Elk, Gauley, and Williams Rivers which reach the Great Kanawha. The surface rocks, aside from alluvial deposists, consist of sandstone, shales, coal, and limestone.

Thirty-two forms of amphibians and thirty forms of reptiles have been recorded from West Virginia. Of these, twenty-four amphibians and twenty reptiles are known to occur in Randolph County. Specimens of each species are included in my private collection; additional specimens of a number of species have been deposited in the Carnegie Museum Collection and in the collection of the West Virginia Biological Survey at Morgantown, West Virginia.

*Cryptobranchus alleganiensis* (Daudin). Hellbender. Common in the Tygart and Shaver's Fork of Cheat Rivers.

*Triturus viridescens viridescens* Rafinesque. Red-spotted Newt. Common in streams, rivers and ponds. Several specimens of the terrestrial form were collected in July in a sawdust pile at Elkwater and under logs at Faulkner. Land phase common in fall.

*Ambystoma maculatum* (Shaw). Spotted Salamander. Found throughout the county in stumps, logs, and underground. Its egg masses are found in pools and sluggish streams from early in March until May.

*Hemidactylium scutatum* (Schlegel). Four-toed Salamander. Two specimens were collected near Elkins on March 27, 1936 in a sphagnum bog that was flooded. Both salamanders were dead.

*Plethodon cinereus* (Green). Red-backed Salamander. Common under bark, logs, and stones throughout the county. Eggs taken on Barton Knob on May 23, 1936; embryos taken at same station on July 31, 1936 at an elevation of 4400 feet. The red-backed phase is more abundant throughout the county.

*Plethodon glutinosus* (Green). Slimy Salamander. Distributed throughout the county but not abundant anywhere.

*Plethodon wehrlei* FOWLER AND DUNN. Wehrle's Salamander. Several specimens collected in old spruce logs on Barton Knob. It has also been collected on White Top and above Mace, the latter at an elevation of 4600 feet.

*Gyrinophilus porphyriticus porphyriticus* (GREEN). Purple Salamander. Common in cold springs and streams throughout the county. One specimen taken from a cave two miles below Elkins. Reese (1934) records this species from two additional caves in Randolph County.

*Pseudotriton ruber ruber* (SONNINI). Common Red Salamander. Found throughout the county in springs and under logs and rocks some distance from the water.

*Eurycea bislineata bislineata* (GREEN). Two-lined Salamander. Found in streams but more often under rocks close to the water. Common near Elkins.

*Eurycea longicauda* (GREEN). Long-tailed Salamander. Abundant along Shaver's Fork of Cheat River where it may be found under logs and stones. Two specimens taken from a cave beside the Tygart River two miles below Elkins.

*Aneides aeneus* (COPE). Green Salamander. Common in crevices of Connoquenessing sandstone on Rich Mountain three miles west of Elkins at an elevation of 2500 feet. This is the eastern most record for this salamander.

*Desmognathus fuscus fuscus* (RAFINESQUE). Dusky Salamander. Common in streams and runs that flow through fields and open valleys. Not found in the swift mountain streams.

*Desmognathus fuscus ochrophaeus* COPE. Mountain Salamander. Very common throughout the county under logs and rocks close to streams as well as some distance from them. Commonly found in upland woods and shady places but not close to lowland rivers.

*Desmognathus phoca* (MATTHES). Seal Salamander. Common in rapid mountain streams up to an elevation of three thousand feet. One specimen collected at Mace at an elevation of 3300 feet. The absence of this specimen in higher altitudes is puzzling.

*Bufo americanus americanus* HOLBROOK. American Toad. Distributed throughout the county. Common near Tygart and Shaver's Fork of Cheat Rivers, especially in the spring. Several specimens collected on Barton's Knob.

*Bufo woodhousii fowleri* HINCKLEY. Fowler's Toad. Common along the large rivers of the county.

*Pseudacris brachyphona* (COPE). Mountain Chorus Frog. Common near Kerens and along the Norton Road west of Elkins. Eggs

deposited in a temporary drainage ditch along the road from April 5, 1936 to June 10, 1936.

*Hyla crucifer* WIED. Spring-peeper. Very common throughout the county. Spawns early in March until middle of April.

*Hyla versicolor versicolor* LECONTE. Common Tree Frog. Found throughout the county. Deposits its eggs from last of June until middle of July. L

*Rana catesbeiana* SHAW. Bullfrog. Common, especially along the rivers.

*Rana clamitans* LATREILLE. Green Frog. Common along rivers and streams throughout the county.

*Rana palustris* LECONTE. Pickerel Frog. Very common along rivers and smaller streams throughout the county.

*Rana sylvatica* LECONTE. Wood Frog. Collected at Elkins, Kerens, and on Barton Knob where it is fairly common. Males heard calling near Elkins on March 11, 1936. One specimen found laying eggs in a pool in the residential part of Elkins.

*Sceloporus undulatus undulatus* (LATREILLE). Swift. One specimen collected at Mingo in the southern end of the county. Common in the bark piles of the Kistler Leather Company at Elkins where it is thought to have been brought, with the bark, from Pendleton County.

*Eumeces fasciatus* (LINNAEUS). Blue-tailed Skink. One specimen collected at Elkins on September 12, 1936. Two specimens seen at Elkins in July on a railroad trestle. Several sight records from Pickens.

*Diadophis punctatus edwardsii* (MERREM). Ring-neck Snake. Several specimens collected near Elkins.

*Heterodon contortrix* (LINNAEUS). Hog-nosed Snake. Rare. One specimen collected at Mingo in 1933.

*Opheodrys vernalis* (HARLAN). Smooth Green Snake. Distributed throughout the county. Many specimens collected near Elkins.

*Coluber constrictor constrictor* (LINNAEUS). Blue Racer. Common throughout the county. Many specimens found on the highways where they have been killed by autos.

*Elaphe obsoleta obsoleta* (SAY). Pilot Blacksnake. Found throughout the county.

*Lampropeltis triangulum triangulum* (LACEPEDE). House Snake. Found throughout the county. Many specimens collected near Elkins.

*Natrix septemvittata* (SAY). Queen Water Snake. Not as widely distributed as the next species. Many specimens collected near Elkins. This form seems to prefer smaller streams where it may be found sunning itself along the bank or hidden under rocks along the edge of the stream. No specimens collected along the rivers.

*Natrix sipedon sipedon* (LINNAEUS). Common Water Snake. Very common.

*Storeria dekayi* (HOLBROOK). DeKay's Snake. Common around Elkins where it may be found under logs and stones and around old buildings.

*Storeria occipito-maculata* (STORER). Red-bellied Snake. Not common. Two specimens collected at Elkins. One specimen taken from under a board at Elkwater.

*Thamnophis sauritus sauritus* (LINNAEUS). Ribbon Snake. This snake is fairly common around Elkins. One specimen in Carnegie Museum collection taken at Huttonsville by Neil Richmond in 1936.

*Thamnophis sirtalis sirtalis* (LINNAEUS). Common Garter Snake. Found throughout the county where it is abundant everywhere.

*Agkistrodon mokasen mokasen* BEAUVOIS. Copperhead. Specimens of this snake are occasionally met with throughout the county.

*Crotalus horridus horridus* (LINNAEUS). Timber Rattlesnake. Occurs on Rich Mt. west of the Tygart River and along the Pendleton County line.

*Chelydra serpentina* (LINNAEUS). Snapping Turtle. Common in the rivers, streams and ponds of the county.

*Terrapene carolina* (LINNAEUS). Box Turtle. Common.

*Chrysemys bellii marginata* AGASSIZ. Western Painted Turtle. Common.

*Amyda spinifera* (LE SUEUR). Spiny Soft-shelled Turtle. At one time common throughout the county; now rare. One specimen collected in Tygart River at Elkins.

A number of species which have not yet been collected in Randolph County are known to occur in bordering counties, and should be added to the Randolph County list upon further search.

They are: *Ambystoma jeffersonianum* (GREEN), *Ambystoma opacum* (GRAVENHORST), *Eurycea lucifuga* RAFINESQUE, *Carphophis amoena amoena* (SAY), *Opheodrys aestivus* (L.), *Sternotherus odoratus* (LATREILLE), and *Clemmys insculpta* (LE CONTE).

The author desires to thank Mr. M. Graham Netting of the Carnegie Museum for critical examination of this manuscript.

# The Postorbital Bone of Podocnemis (Chelonia)

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College of the City of New York

In the skulls of the family Pelomedusidae of the suborder Pleurodira, the temporal fossa is usually covered by rather broad bony plates of the lateral arcades. These bones are the jugal, postorbital, quadratojugal, parietal, and sometimes the frontal. In the most primitive genus *Pelomedusa* the postorbital is rather large and extends back far enough to contribute to the anterior border of the temporal fossa. In the more advanced species of such genera as *Pelusios*, and *Podocnemis* the parietal and quadratojugal unite over the fossa in such a way that the postorbital, while still present, is reduced proportionately and excluded from the front of the incisure. This is quite in contrast with the pattern of the Cryptodiran skulls where the postorbital never, so long as it persists, becomes excluded from that border, except in marine species. It appears to be an evolutionary trend in all Chelonia, except marine species, that the postorbital bone gradually be reduced in size, but seldom if ever shifted from its primary position, i.e., the caudal boundary of the orbit between the jugal and frontal.

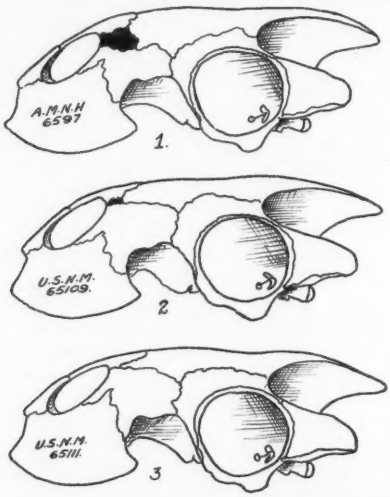
Recently while examining skulls of the genus *Podocnemis* in the collection of the United States National Museum, an interesting discovery was made. The normal skull of *Podocnemis expansa* (Fig. 1)* has a very definite postorbital bone present in front of and between the jugal, frontal, and parietal but remote from the quadratojugal with which it articulates in the older genus *Pelomedusa*. Although this bone is smaller than those surrounding it, it is still a conspicuous member of the lateral side of the skull in all specimens of *Podocnemis* that I have previousy examined.

In skulls of three individuals (U. S. N. M. nos. 65109, 65110, and 65111) all of the same species (probably *P. expansa*, although not so named in the records of the National Museum), all of the same age, all from the same locality and all collected by the same individual (Dr. Wm. Mann), one (U. S. N. M. 65109, Fig. 2) has abnormally small postorbital bone while the other two (U. S. N. M. 65110 and 65111, Fig. 3) have no postorbital whatsoever nor any indication that one ever existed in these specimens.

This is the only case I know of in the Chelonia where a basic pattern has been changed by the total loss of a bone yet the contour of the entire skull left unmodified. It appears that the value of the postorbital in this group of turtles is insignificant, its presence being a heritage from those ancestors where it was of greater mechanical importance. The cause of its gradual diminution and eventual loss

*In figures 1 and 2, the postorbital bone is represented in solid black.

is problematical. We must accept the idea that the presence, size and position of a cranial element is a character determined genetically. It can also be conceived readily that each such element would be subject to limited ranges in variation. This would affect primarily size and position; each would however have to be limited due to the necessity of maintaining a certain mechanical integrity essential for the well being of the entire skull. The roofing bones of the skull are of dermal origin and develop as thin plates from definitely established osteogenetic centers. The number and place of these centers are probably determined genetically. The speed with which and the direction in which the ossification proceeds from each center is likewise the result of some genic influence.




Where several centers are closely approximate their methods and time of development must be interrelated. Suppose three osteogentic centers, close together, called A, B, and C, are to give rise to three dermal bones which under normal conditions will become synarthrotically articulated; the way any one center develops will depend upon how the other two behave. Assume there are two specimens of the same species; if center A in one specimen develops more rapidly in one direction than it does in the second specimen the growth of centers B and C in the first specimen will be different than in the second for they must be correlated with the growth of center A in the first specimen. If this cooperative development were

lacking there would be no assurance of establishing a mechanical proficiency in the construction of the skull and there might arise a deficiency which would result in collapse or in the improper completion of the skull pattern. This would lead to the elimination of the individual so affected.

Of course there is always involved and intricately tied up with the genetic determination the regulatory effect of endocrine secretions on the development of bones. To what extent such hormones influence the definitive pattern of a skull is difficult to say. Patterns and architecture must be determined by genes, otherwise duplication would be the exception rather than the rule. After the initial determination of the number and position of elements is established and the internal architecture laid down the variations observable are probably the result of some endocrinal control coupled with the mutual growth effects of adjacent elements.

In the cases of the skulls of *Podocnemis* here cited it appears that in one case (U. S. N. M. 65109) genic determination prescribed the presence of a minute postorbital bone where normally there should be a much larger one. In the other cases (U. S. N. M. 65110, 65111) genic determination eliminated the postorbital altogether. The result then left a space between the adjacent jugal, frontal and parietal. In order to complete the skull pattern and insure a mechanical perfection, these three bones without the hindering presence of the fourth, continued to grow across the space normally occupied by the postorbital and eventually met in a synarthrotic union.

## Recent Snake Books

Four interesting and attractive popular snake publications—two books and two "state" booklets—have come to our attention during as many months, and the rumors of several others in preparation, will we hope, permanently awaken the American publishers to the fact that there is an interest and a market for popularized and yet scientific books on herpetology. No one book, or even one type of treatment will appeal to the varied interests who come to our museums to seek information; the two books reviewed here present two viewpoints—we hope that others may appear soon. Both books are free from typographical errors to a surprising degree and both have a good index.

SNAKES AND THEIR WAYS. By C. H. Curran and Carl Kauffeld. Harper, 1937. xvii, 285 p., 62 figs. 2nd ed.! $3.50. Apparently an exact reprint of the "first" edition with the snake on the cover still upside-down; bats refered to as rodents, and references to the exoskeletons of worms, and a number of minor errors still in the text. The illustrations seem to be picked because of their availability at the American Museum rather than for their usefulness by the American reader. The book treats the snakes by groups divided partly systematically and partly by habitat; a division which is disturbing to the systematist, but one which will be liked by many of the lay-readers. The aim of the authors was to answer the most frequent

questions, about snakes—and they have succeeded in this most admirably; that they have not given additional information to arouse interest in other matters which are not subject to question by the museum visitor but should be of equal interest, may be attributed entirely to lack of space. Snake stories and beliefs are explained or refuted thruout the book, and give the type of information desired by the casually interested. The usefulness of a check list of snakes in such a volume is somewhat questionable; the thirty pages could have been better used in expanding any of the other chapters. A book decidedly to be recommended to those wanting the spectacular and the talked about rather than a general background.

SNAKES ALIVE AND HOW THEY LIVE. By CLIFFORD H. POPE. Viking Press, 1937. xii, 238 p., 28 figs., 32 pls. $2.50. Although considered by the publisher as juveniliana, this book seems to have an even greater appeal to adult readers. The charming style and lack of unnecessarily technical language is not accompanied by the usual "talking down to" of juvenile books. Its information is up-to-date to a degree which has been very infrequently attained by popular books; the frequent credit given to other workers in the field is most gratifying to them and will make the lay-herpetologist realize that there is more than one person studying snakes in America! The thoroughness and completeness of the book can be judged by the chapter headings: usefulness, size, age and growth, senses and intelligence, feeding, reproduction, locomotion, defense, enemies, where snakes live, hibernation, popular beliefs, snakes as medicine, snake hunting, snakes as pets, venoms, snake bite and its treatment, and classification. And each chapter treats its subject adequately and well. The illustrations are exceptionally well chosen to supplement the text, and of a quaity considerably above the average. A simple key to species (not subspecies) is appended and very usable; a distinct improvement, however, would have been to follow the style of Blanchard —a numbered dichotomous key not split up into groups nor separating the keys to species of each genus. The most notable feature about the whole book is its effective stimulation of a sympathetic interest and friendliness toward snakes—an attitude which needs to be developed and one which no previous American book has succeeded in arousing. Few popular books really "popularize" their subject matter; Mr. Pope's book does.

SNAKES OF MARYLAND. By HOWARD A. KELLY, AUDREY W. DAVIS, and H. C. ROBERTSON. Natural History Society of Maryland, Baltimore, 1936. 103 p., 33 figs., 10 colored plates. A concise summary of snake biology and ecology in 14 pages is followed by excellent accounts embracing description, habits, range, and definite Maryland records, for twenty eight species. The photographs are excellent and refreshingly new. The paintings by R. F. Deckert which illustrate most of the species are exceptionally well done and generaly include line drawings of the head and a small "habitat" inset. The color work, although it may be critized in some particulars, is the best which has appeared in any American publication on snakes.

A GUIDE TO THE SNAKES OF NEW JERSEY. By HAROLD TRAPIDO. Newark Museum, 1937. 60 p. Twenty-one species are keyed and subsequently described giving size, color, range, habitat and habits. Each species is illustrated by an excellent photograph (also previously unpublished) and a section of the body pattern. A commendabe style for other small regional projects.